PARASITE EXTINCTIONS — WHY CARE?

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If a host becomes extinct, does it matter that its parasites also become extinct? At least half the world's biota is parasitic, therefore it would seem important to understand the role of parasites within ecosystems. As case studies, the unique, parasitic fauna of two endangered Australian mammals — the Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*) and the False Water Rat (*Xeromys myoides*) — provide insights into the question. In each case, parasite biogeography gives additional data on host origins, speciation patterns or host behaviour. As well, management strategies that involve controlling or eliminating parasite infections may be in error, because a parasite becoming extinct before its host might have a negative effect on host conservation. ☐*Parasites, biogeography, host-parasite relationships, conservation, endangered, Xeromys, Lasiorhinus, Queensland, Australia.*

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It is generally accepted by parasitologists — although rarely acknowledged by others — that there are more parasitic species than non-parasitic ones. This is thought to be true even when viruses, rickettsias, bacteria and fungi are discounted (Schmidt & Roberts, 1989). Thus, if at least half the world's biota is parasitic, and those organisms that are not parasitic are hosts (Schmidt & Roberts, 1989), then parasites must form a major part of the diversity of life. Furthermore, because this diversity is the foundation for the continued existence of a healthy planet (Biodiversity Unit, 1993), then parasites must be very important.

Recent analyses of biodiversity (Stork & Gaston, 1990; Lewin, 1991) suggest that more species of insects have been described — and more are awaiting description — than for any other group. Be that as it may, every kind of insect that has been examined has harboured at least one species of parasitic nematode, as well as other ecto- and endo-parasites. Therefore, there are probably as many parasite species awaiting description as insects. Consequently, there should be at least as much concern about undescribed parasites as there is for the insects.

So what attention has been paid to parasites in the biodiversity debate? It seems that although invertebrates are now being valued as species in their own right (or as flagship species or indicators of environmental health), the role of parasites in ecological systems continues to be largely ignored. As Munger & Karasov (1991) noted, theoretical work in the late 1970's sparked some interest in the regulation of host abundance by parasites. Studies of host-parasite interactions, however, provided only limited insight into the role of parasitism within ecosystems.

Parasitologists are now becoming more sensitive to the issue of parasite extinction. For example, 'EQUAL RIGHTS FOR PARASITES' was used by Windsor (1990) to draw attention to their importance. Parasite species are not simply pathogenic agents but species with their own evolutionary value.

> Parasites are the ubiquitous, yet usually invisible component of animal communities .... they influence population dynamics of host species and hence influence the diversity and abundance of organisms in the environment (Minchella & Scott, 1991).

Even so, attention has more often been caught by the plight of a rare or endangered host species than the possible extinction of its parasites.

The following two case-studies illustrate that rare, host species can harbour rare species of parasites, and that understanding the interrelationship of the host and the parasite is important. These parasites have only been recently discovered.

ENDANGERED SPECIES

NORTHERN HAIRY-NOSED WOMBAT

The first case study is a nematode (Cloacinidae) parasitic in the colon of the Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*).

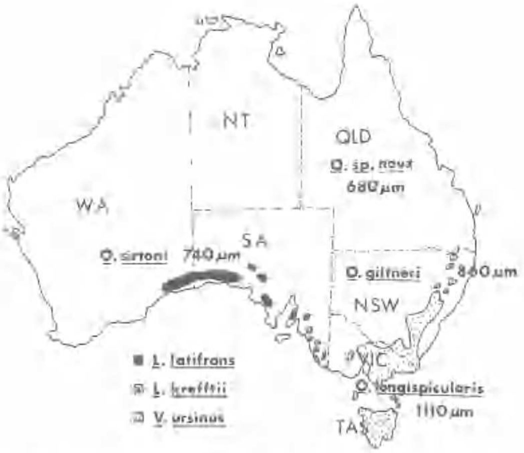

FIG. 1. The distribution of wombats in Australia compared with the distribution of *Oesophagostomoides* spp. Mean spicule lengths of the nematode species are given.

This host is one of Australia's most endangered mammals, known from a single colony of about 70 individuals in Epping Forest National Park, north-west of Rockhampton, Central Queensland. It, *L. latifrons* (Southern Hairy-Nose) and the Common Wombat (*Vombatus ursinus*) comprise the living Vombatidae; five other wombat genera are know to be extinct (Wells, 1989). Hairy-nosed wombats can be distinguished from Common Wombats by their hairy (not smooth) noses, larger ears, silky coats and skull features (Wells, 1989). Northern and Southern Hairy-noses can be distinguished from each other by differences in skull features (Wells, 1989) *and* helminth parasites.

Wombat distribution has been considerably reduced since European settlement (Fig. 1). During the late Tertiary to Pleistocene, the Common Wombat occupied the coastal margins and ranges from SW Australia and Tasmania, north to southern Queensland, while the hairy-nosed species preferred drier, inland conditions (Wells, 1989). Wombat species probably overlapped at the margins of their ranges, for example fossil evidence of *L. krefftii* has been found in known *V. ursinus* range (Gordon, 1991).

Northern Hairy-nosed Wombats spend the day in their burrows, making it difficult to retrieve dead bodies or dying animals for further study. However, a juvenile male was discovered in a moribund condition by a National Parks ranger in 1991. The animal's body was frozen and sent to the Queensland Museum. There it was fixed in 10% formalin and then stored in alcohol. Cestodes were found in the small intestine and nematodes in the colon.

The only previous record of a parasite from *krefftii* is a cestode, recorded in 1923 as *Paramoniezia suis*, a species normally found in pigs. Beveridge (1976) suggested it was probably *P. johnstoni*, the cestode usually found in *V. ursinus* and *L. latifrons*. Unfortunately the poorly preserved material made definite identification impossible and the identity of the cestode fauna of the Northern Hairy-nosed Wombat therefore remains confused.

The nematodes (149mm ♂♂ and 278 ♀♀) probably represent an undescribed species of *Oesophagostomoides*. This strongylid genus is exclusive to wombats, and includes two species from the Common Wombat and one from the Southern Hairy-nosed Wombat. All four species are similar at the anterior end, having a cylindrical buccal capsule; an external leaf crown of 8 elements and internal leaf crown of 16-32 elements; and in having the duct of the oesphageal gland pierce the wall of the buccal capsule, divide internally and form an encircling groove (Fig. 2A). It appears that these new specimens cannot be identified as any known species since they differ in the following characters: the proportions of the tail and the position of the vulva in the female; and the length of the spicule (Fig. 1) and the shape of the dorsal ray and gubernaculum in the male.

It would be interesting to compare speciation within *Oesophagostomoides* with wombat speciation to confirm patterns of co-evolution of host and parasite, but a full range of comparative morphological and molecular data for phylogenetic analysis will be difficult to get. Questions about the relationships between the host and the parasite species, and the extent to which they have co-evolved, remain unanswered.

These questions, however, are critical for wombat conservation. For example, to what extent is this tiny remnant of hairy-noses threatened by disease and are its parasites a threat to its very survival? Are the wombats and the parasites in a symbiotic relationship? (see also Bryant, 1992). Are both an integral component of each other's ecology?

The answers are important. A management strategy that involves controlling or eliminating parasite infections may be in error because, if a parasite becomes extinct before its host, there might be a negative effect on the conservation of

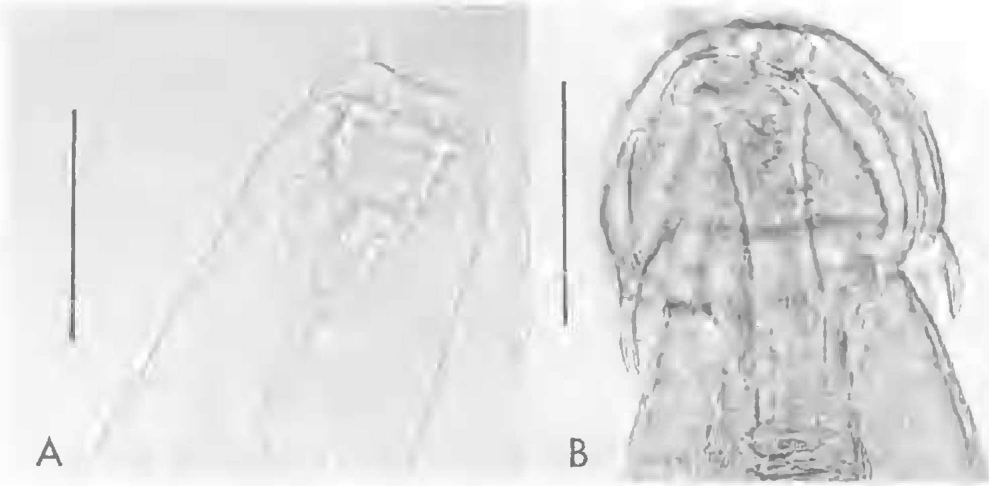

FIG. 2. A, Photomicrograph of the anterior end of *Oesophagostomoides* n.sp. from *Lasiorhinus latifrons*. Scale line 0.1mm. B, photomicrograph of the anterior end of the nematode from *Xeromys myoides*. Scale line 0.1mm.

the host (Rózsa, 1992). Parasites exert selective pressure on their hosts — so saving a host without its parasites might result in a decline of intraspecific genetic diversity, ultimately affecting the survival potential of the host (Rózsa, 1992).

Population geneticists build mathematical models to predict the size of minimum, viable populations to help conservationists design management programs. There is little doubt, however, that these models will be unreliable without accounting for the effects of parasites.

False Water Rat

An acuariod nematode living in the stomach of the False Water Rat (*Xeromys myoides*) is the other case study. The False Water Rat is the only species in a distinctive Australian genus. It resembles several Papua New Guinean rodent species in morphology and ecology and may be a relatively recent (in evolutionary terms) invader from Papua New Guinea (Watts & Aslin, 1981). *X. myoides* is known from only six localities and it was listed by the Council of Nature Conservation Ministers in 1991 as a vulnerable species (Van Dyck, 1992). Until 1992, there were only 14 specimens held in museums with a further 12 individuals observed or trapped-and-released in the wild (Van Dyck & Durbidge, 1992). The diet of the rat includes marine invertebrates such as crabs, mud-lobsters, mussels, marine pulmonates and polyclads (Van Dyck, 1994).

Nematodes were found in the stomachs of four out of four Queensland Museum specimens, which had been fixed in 10% formalin and subsequently examined for parasites. The specimens might represent an undescribed species. Their generic allocation, however, is in dispute. Two different groups of workers have described two similar (probably synonymous) species from *Rattus argentiventer* (Rice Field Rat) from Java. Moreover, because of the authors' differing interpretations of the features of the anterior end of the nematode, the worms were assigned to different genera: *Tikusnema* (Hasegawa et al., 1992) and *Molinacuaria* (Gibbons et al., 1992). The specimens from *X. myoides* have similar features to both described species but differ in proportions. As well, the cuticular leaves of the pseudolabia differ in shape (Fig. 2B).

It is not known whether there is a connection between Rice Field Rats from Java and False Water Rats from Australia. The presence of closely related nematodes in these two, now widely geographically separated hosts, could provide further clues to the origins of *Xeromys*. If there are similar parasites in Papua New Guinean rodents, it will add weight to the suggestion that *Xeromys* is a relatively recent arrival from Papua New Guinea.

Acuariod life-cycles invariably include arthropods as intermediate hosts (Schmidt & Roberts, 1989). The presence of an acuariod parasite, at a high prevalence, in the False Water Rats is therefore an indicator of the importance of crustaceans in their diet.

CONCLUSION

Both these case studies illustrate the intrinsic interest in revealing as yet undiscovered parasite fauna. They also illustrate the need for caution in determining conservation strategies for species in which parasites are yet unknown, and where host-parasite relationships are poorly understood. Until effects of parasitism on host demography, physiology, competition and predation are appreciated we cannot afford to ignore parasitic infestations. Attempts to tease out the effects of sub-lethal infections of parasites on populations of hosts (studies such as that on White footed Mice by Munger & Karasov, 1991) are difficult. The effects of presence or absence of infection on an individual host may be confounded by other factors, so that more questions are formulated than answered.

Equal rights for parasites, however, can be argued if the goal is to conserve all species, not just those with outward appeal. But, leaving such arguments of intrinsic worth aside, how can successful conservation strategies be developed for more obviously valued animals, if the parasites, which form an integral part of each ecological community, are not also conserved? The totality of the biosphere, including the usually invisible parasite component, must be maintained.

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